

OPERATOR'S MANUAL

Model A931
Waveform
Test Set

Preliminary Copy

MP MASTER



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Scientific
Atlanta

**Model A931
Waveform
Test Set**

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Operator's Manual

First Edition

July, 1988

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INSTRUMENTATION

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CHAPTER 1 GENERAL INFORMATION

1.1 INTRODUCTION

This instruction manual contains information about operating the Scientific-Atlanta Model A931 Waveform Test Set. Before operating this unit, read Chapters 2 and 3 carefully.

1.2 PURPOSE OF EQUIPMENT

The Waveform Test Set, a portable single chassis unit, provides waveform measurement and analysis of DS1 and DS3 input signals. The test set operates in the PASS/FAIL mode when a DS1/DS3 input signal type is selected and applied. The Model A931 Test Set produces a PASS or FAIL indication of three key parameters of the input DS1/DS3 signal. The key parameters are peak voltage, pulse width, and pulse symmetry. If more detailed information on the signal is required, an eight-character alphanumeric display is available. The test set's internal memory is preprogrammed to compare the waveshape against the industry standard CB-119 template.

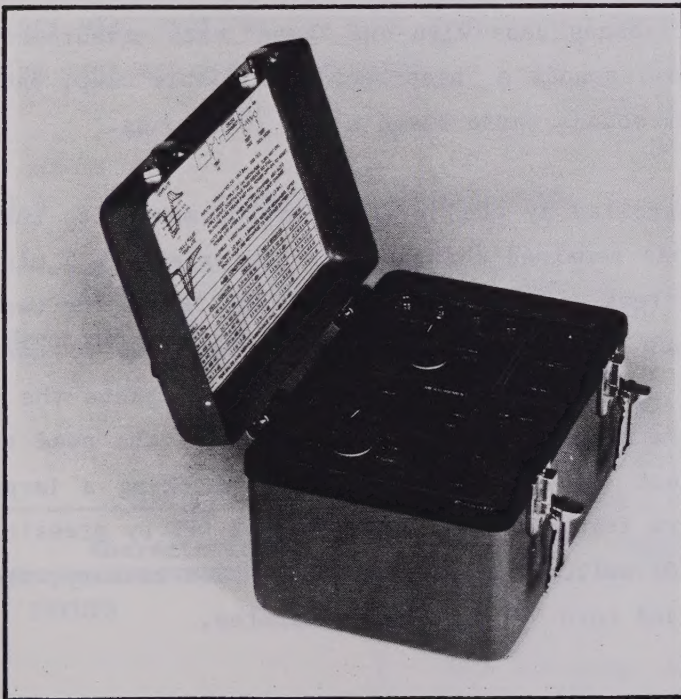


Figure 1.1. The Model A931 Waveform Test Set

1.3

FEATURES

The Waveform Test Set's front panel is divided into three sections: Measurement, Recharge and Test Input. The Measurement section includes an eight-character alphanumeric display (VALUE), six discrete indicators, audible beeper, display selection switch and the POWER ON switch. The rotary switch selects the measurement for display. The available selections include: OFF; dBx (peak-to-peak pulse voltage referenced to expected peak-to-peak pulse voltage); -Vp (negative pulse peak value); +Vp (positive pulse peak value); + WIDTH (positive pulse width); - WIDTH (negative pulse width); SYM (positive/negative pulse symmetry); and AUDIBLE (activates audible alarm). The decimal point flashes in the display to indicate it is being updated.

The Waveform Test Set displays the pulse widths at three amplitude points: 25% peak (L), 50% peak (M) and 75% peak (H). The display SELECT switch, when set to the OFF position, conserves battery life because only the PASS/FAIL indicators will be active. The Audible Alarm position allows the PASS or FAIL result to be indicated by beeping tones when you cannot see the display. The Waveform Test Set sounds pass with one "beep" each measurement cycle, or once per second. A fail sounds a "beep-beep", or double beep, each measurement cycle. A low battery sounds three beeps every 10 seconds.

The POWER ON switch is controlled by the internal microcomputer to turn the test set OFF if the input has remained constant for approximately 5 minutes and no ac is applied to the test set. Application of 120V ac to the test set disables the timeout sequence. If using the Waveform Test Set to make repeated measurements, each new application of an input signal resets the 5 minute time-out timer. Resetting the time-out timer eliminates the need to continually re-initialize the test set while, for example, checking a large cross connect panel. The Waveform Test Set may also be turned OFF by pressing the bottom portion of the POWER ON switch. In the event of a low battery, the Waveform Test Set will time-out and turn OFF in about 5 minutes.

The Recharge section of the Waveform Test Set provides a convenient power receptacle which allows recharging the battery and operating the unit on 120V ac. The test set contains sealed lead-acid rechargeable batteries which pro-

vide a minimum of 5 hours of continuous use. A characteristic of lead-acid batteries is that their life is extended if kept at full charge and not allowed to deeply discharge. A low battery (LOW BAT) LED indicates that the dc source is nearing the "drop-out" operating range and should be recharged. The Waveform Test Set will operate from a 120V ac input without waiting for the batteries to recharge.

The Test Input section has a front panel rotary switch which allows selection of one of five input types: DSX1, DSX1-MON (-20 dB), DSX3, DSX3-MON (-20 dB) or DS3-HI. In the monitor (MON) mode an internal 20 dB amplifier compensates for the 20 dB attenuation at the monitor jacks, so that the signal may be compared against CB-119 templates. The Waveform Test Set provides four input connectors for compatibility with DS1 Bantam, DS1 WECO 310, DS3 440 or 558 plug. The switch and connectors comprise the input selection and control.

The Waveform Test Set has a history feature when the unit operates on ac power. The history capability allows an extended signal test since the indicators will blink after the test set detects an error condition. The indicators will continue to blink until the test set is reinitialized, by switching the test set OFF and back ON.

1.4 TECHNICAL SPECIFICATIONS

Table 1.1 summarizes the technical specifications for the Model A931 Waveform Test Set.

Table 1.1
Technical Specifications

Characteristic	Specifications
INPUTS	DS1 Connectors (2): WECO 310 plug, 100 Ω Balanced Bantam, 100 Ω Balanced

Table 1.1 - continued

Characteristic	Specifications
	Levels: Accepts the following input levels: DSX-1 (normal) DSX-1 MON level (-20 dB) DS3 Connectors (2): 440 plug compatible, 75 Ω 558 plug compatible, 75 Ω Levels: Accepts the following input levels: DSX-3 DSX-3 MON DS3-HI
TEST INPUT SELECT (switch)	Rotary switch to select input type: DSX-1, DSX-1 MON, DSX-3, DSX-3 MON or DS3-HI.
MEASUREMENT SELECT (switch)	Rotary to select measurement for display: +Vp, -Vp, +Pulse Width, -Pulse Width, Symmetry, dBX, Audible Alarm and Off.
Measurements +Vp and -Vp	These are the sampled voltages in the middle of the pulse, relative to the measured data zero point, not the ac zero. The test set determines the zero crossing for the samples and corrects the peak voltages for asymmetry, which may offset the data zero from the ac zero point. The test set measures the peak amplitude to $\pm 5\%$ for DSX-1 and DSX-3; $\pm 8\%$ for DS3-HI; and $\pm 10\%$ for DSX-1 and DSX-3 MON.
dBX	The peak-to-peak voltage is scaled in dB, relative to the nominal expected peak voltages (0 dBX) for each of the input ranges and output to the display in +dB (greater than nominal) or -dB (less than nominal). The 0 dB reference for each range is: DSX1-MON = 5.88Vp-p DSX1 = 5.88Vp-p DSX3 = 1.10Vp-p DSX3 MON = 1.10Vp-p DS3-HI = 1.10Vp-p
Widths	From the sampled data, pulse widths are determined at three amplitude points, relative to the zero crossing. These are the 25%(L), 50%(M) and 75%(H) peak voltage points. When

Table 1.1 - continued

Characteristic	Specifications
	Levels: Accepts the following input levels: DSX-1 (normal) DSX-1 MON level (-20 dB) DS3 Connectors (2): 440 plug compatible, 75 Ω 558 plug compatible, 75 Ω Levels: Accepts the following input levels: DSX-3 DSX-3 MON DS3-HI
TEST INPUT SELECT (switch)	Rotary switch to select input type: DSX-1, DSX-1 MON, DSX-3, DSX-3MON or DS3-HI.
MEASUREMENT SELECT (switch)	Rotary to select measurement for display: +Vp, -Vp, +Pulse Width, -Pulse Width, Symmetry, dBX, Audible Alarm and Off.
Measurements +Vp and -Vp	These are the sampled voltages in the middle of the pulse, relative to the measured data zero point, not the ac zero. The test set determines the zero crossing for the samples and corrects the peak voltages for asymmetry, which may offset the data zero from the ac zero point. The test set measures the peak amplitude to $\pm 5\%$ for DSX-1 and DSX-3; $\pm 10\%$ for DS3-HI, DSX-1 and DSX-3 MON.
dBX	The peak-to-peak voltage is scaled in dB, relative to the nominal expected peak voltages (0 dBX) at the DSX (cross-connect) point and output to the display in +dB (greater than nominal) or -dB (less than nominal). The 0 dB reference for each range is: DSX1-MON = 5.88Vp-p DSX1 = 5.88Vp-p DSX3 = 1.10Vp-p DSX3 MON = 1.10Vp-p DS3-HI = 1.10Vp-p
Widths	From the sampled data, pulse widths are determined at three amplitude points, relative to the zero crossing. These are the 25%(L), 50%(M) and 75%(H) peak voltage points. When

Table 1.1 - concluded

Characteristic	Specifications
Widths - cont.	selecting the pulse width for display, the three measured values scroll through the display at a 1 second rate. The Waveform Test Set determines the pulse width to within $\pm 10\%$ accuracy.
Symmetry	Symmetry is the ratio of the positive pulse power to the negative pulse power. It is calculated by: $10\log\left[\frac{(+V_p)^2(0.5\text{width})}{(-V_p)^2(-0.5\text{width})}\right]$ and displayed in dB format.
Indicators	PASS/FAIL LEDs indicate whether the input waveform falls within the values specified by the industry standard. Measurement tolerance error is placed on the PASS condition to minimize erroneous FAIL indications.
Peak Voltage Fail Points	DSX1 - $<2.28V_p$ (-2.2 dB), or $>3.78V_p$ (+2.2 dB) DSX1-MON - $<0.192V_p$ (-23.7 dB), or $>0.432V_p$ (-16.7 dB) DSX3 - $<0.34V_p$ (-4.2 dB), or $>0.89V_p$ (+4.2 dB) DSX3-MON - $<28mV_p$ (-25.9 dB) or $>102mV_p$ (-14.6 dB) DS3-HI - $<0.57V_p$ (+0.3 dB), or $>1.44V_p$ (8.4 dB)
Pulse Width Fail Points	Figure 1.2 shows the DS1 and DS3 pulse templates and the Waveform Test Set PASS conditions.
General	Size: 5.5" x 8.0" x 4.9". Weight: 5 pounds. Power: Battery operated, ac recharge at 120V ac, 10 Watts recharge in 8 hours, internal overcharge protection. Temperature: Operating 0 to 50° C, Storage -20° C to 65° C.

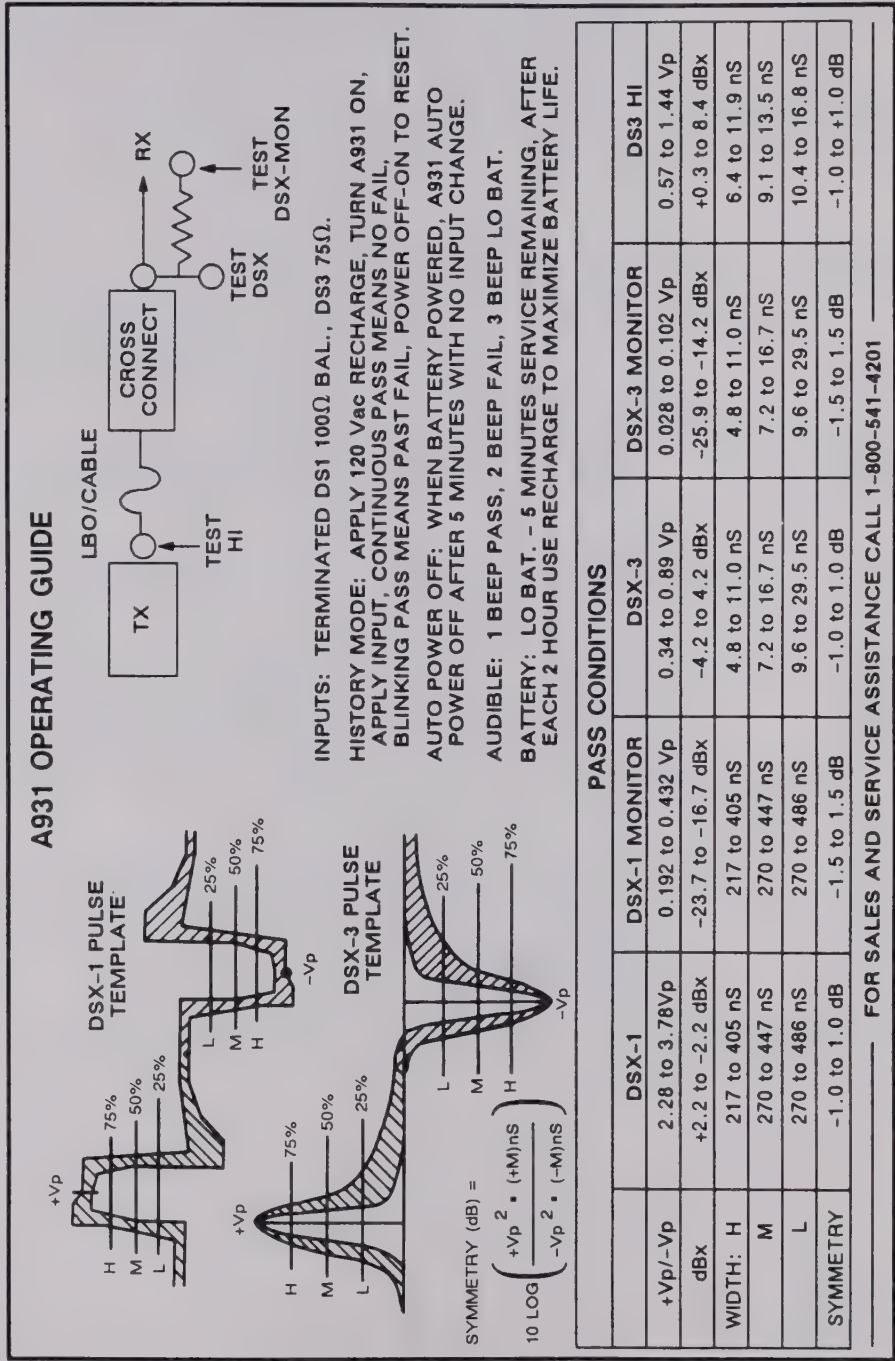


Figure 1.2. DS1 and DS3 Templates Pass Conditions

CHAPTER 2 INSTALLATION

2.1 UNPACKING AND INSPECTION

Carefully unpack the test set and inspect for any damage possibly occurring in transit. If damage is evident, contact both the carrier and the nearest Scientific-Atlanta representative immediately. Be sure to save the packing materials and shipping papers as evidence for inspection by the carrier's representative. Do not return the test set to Scientific-Atlanta without specific return shipment instructions.

The shipping carton and packing material will also prove valuable should there ever be occasion to ship the unit. The carton and internal pack are specifically designed for protecting the test set during transit.

An inventory checklist is provided in Section 2.2 for accessories supplied with the unit. Should an item be missing (or damaged) from the kit, contact your local Scientific-Atlanta representative for assistance.

2.2 ACCESSORIES SUPPLIED

The Waveform Test Set comes complete with the following items:

Operator's Manual	320039
Power Cord	82801
Fuses - 0.1 A	328111

2.3 SAFETY PRECAUTIONS

Read the following safety information before applying power to the Waveform Test Set:

1. Grounding - This unit is grounded through a ground conductor on the power cord. To avoid electrical shock, connect the power cord only to a properly wired receptacle that provides a ground connection. This is essential for safe operation when using ac power to operate the test set.
2. Fuses - to avoid possible damage to the test set, only use fuses of the type, voltage, and current rating specified.
3. Power Cord - Use only the power cord specified.
4. Case - Do not remove the test set from the case while power is applied. Do not operate the test set unless it is properly installed in the case.

NOTE

Maintenance or service on this test set must be performed only by trained service personnel. Repair is limited to battery replacement.

2.4 INSTALLATION PROCEDURES

2.4.1 Recharging the Batteries

The internal batteries are sealed, lead-acid type. To maximize battery life, recharge the batteries after each 2 hours of use even though the batteries have approximately an 8-hour operating charge. The internal charger operates in a dual mode supplying a rapid recharge current source and then switching to a voltage mode after reaching full charge. Leaving the Waveform Test Set connected to 120V ac after reaching full charge will not reduce battery life.

If the LOW BAT indicator sounds or lights, you can connect the Waveform Test Set to a 120V ac line and use it immediately. The battery charging circuit has extra capacity to drive the operating circuits and recharge the batteries simultaneously.

2.4.2 Connecting Inputs

Two industry standard connector types are provided for both of the DS1 and DS3 inputs. For other input connector types, use adapters. The two inputs are internally summed with resistive matching pads which also provide isolation. Consequently, only one DS1, or one DS3, input should be applied to the test set at a time.

CHAPTER 3 OPERATION

3.1 INTRODUCTION

The Waveform Test Set is a one-button instrument requiring a signal input, an operating mode selection, and power turned ON. The test set will then perform the measurement and indicate the results. To reduce errors due to interpretation of results, PASS/FAIL indicators are provided. For more detailed information, the display mode can be selected and the measurement results displayed. For operation where the test set may not be easily viewed, an internal Audible Alarm can be used to signal the results of a measurement. A single "beep" after each measurement means the input meets the industry standard specifications. A double "beep-beep" indicates the signal falls outside the industry standard and thus fails.

3.2 FRONT PANEL CONTROLS AND INDICATORS

The front panel control switches and indicators of the Model A931 Waveform Test Set are identified numerically in Figure 3.1. Understanding these control switches and indicators before initiating a test provides test procedure results containing the information desired. Table 3.1 lists the functions of the control switches and indicators.

3.3 OPERATING PROCEDURES

3.3.1 Operation Overview

The Waveform Test Set performs waveform measurements on either DS1 or DS3 inputs. The test set compares measurement values against industry standards for the selected input type to light the PASS/FAIL indicators. Measured val-

ues may also be displayed on an eight-character alphanumeric display. Operation consists of applying the input to be measured to the input connector, selecting the proper input type and pressing the POWER ON switch. After an internal self-check, the Waveform Test Set immediately performs a measurement on the input signal, compares these measurements against internally stored industry standard templates, and lights the appropriate PASS/FAIL indicators.

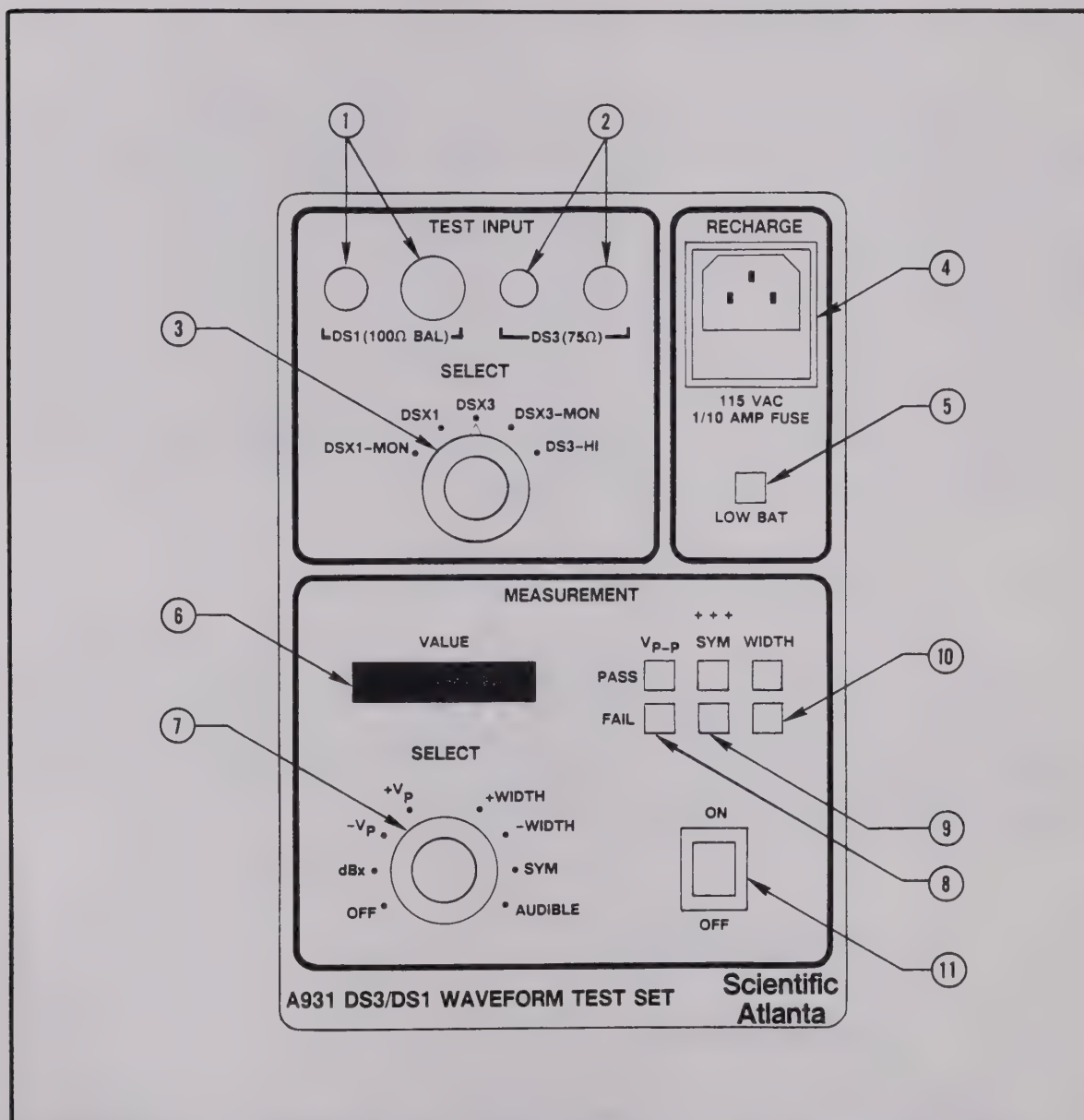


Figure 3.1. Waveform Test Set Controls and Indicators

Table 3.1
Identification of Controls and Indicators

Reference Symbol	Panel Label	Functional Description
1	DS1 (100 Ω BAL)	Bantam and WECO 310 input plugs for DS1 test signal inputs. Adaptors permit the use of other input connectors.
2	DS3 (75 Ω)	Accepts 440 and 558 plugs for a 75 Ω DS3 test signal input. Adaptors permit the use of other input connectors.
3	TEST INPUT SELECT	Five-position rotary switch; selects among five possible signal test sources. DSX1-MON and DSX3-MON are 20 dB below the normal DSX points and are called bridging monitor points. The DSX-MON position adds 20 dB gain to the input signal to compensate for the input attenuation from a - cross-connect monitor point.
4	RECHARGE	Input connector and 0.1 A fuse for application of the 115V ac used to recharge the Waveform Test Set lead-acid batteries.
5	LOW BAT	Red LED; lights to indicate the internal battery capacity is nearly discharged. The test set will turn itself OFF approximately 5 minutes after this indicator lights unless ac is applied.
6	VALUE	Eight 5x7 LED matrices that display the results of the test selected by the two SELECT switches. The microprocessor updates the display once per second.
7	MEASUREMENT SELECT	Eight-position rotary switch; selects test results to the display. OFF disables the display. The dBx position displays the input signal in dB, relative to the DSX voltage level of the input signal. For example, a normal DSX3 input is 1.10Vpp, but if the measured DSX3 signal is only 0.55Vpp the display would show -6.0 dB when dBx is selected. The +Vp and -Vp positions enable the display to indicate the measured peak amplitudes of the input signal. The +WIDTH and -WIDTH positions enable the test set to display the positive or negative pulse width. The test set determines the signal peak amplitude then measures the pulse width at the 25%, 50% and 75% points. Each second,

Table 3.1 - concluded

Reference Symbol	Panel Label	Functional Description
7	SELECT - cont.	the test set displays the LO (L), MED (M), and HI (HI) value for the selected input signal. The SYM position calculates the signal power in dB. If the positive pulse power exceeds the negative pulse power, the test set will indicate a +dB result. If the negative pulse power is greater, the test set indicates -dB. 0 dB is ideal. The AUDIBLE position enables the Audible Alarm to signal a beep-per-second for a test pass and a beep-beep per second for a test fail.
8	V _{p-p} PASS/FAIL	Red and Green LEDs indicate the result of the peak-to-peak voltage measurement of the test signal input. Red indicates fail and green indicates pass. Use the SELECT switch and display to evaluate test signal inputs.
9	SYM PASS/FAIL	Red and Green LEDs indicate results of the symmetry power measurement of the test signal input. Green indicates pass and red indicates fail. Use the SELECT switch and the display to evaluate the test signal input.
10	WIDTH PASS/FAIL	Red and Green LEDs indicate the result of the pulse width measurements of the test signal input. Red indicates fail and green indicates pass. Use the SELECT switch and the display to evaluate the test signal input.
11	ON/OFF	Rocker switch turns the test set ON/OFF. The microprocessor also disables the test set if it receives no test signal inputs within 5 minutes when operating on batteries.

The Waveform Test Set executes measurements by scanning the applied input waveform and storing a pulse shape image in RAM. Since the test set processes the data "on-the-fly" by isolating positive and negative pulses for digitization, the input may be live traffic, pseudorandom test patterns, blue signals or all ones. However, high intersymbol interference with all ones patterns at DSX3 will cause unstable measurements. (Note the all ones pattern is rarely used with DS3 rate transmission.) A DSX3 blue signal provides the

most consistent results since pseudorandom or live traffic contains higher intersymbol interference. See Appendix A.4 for a complete discussion of data pattern effects. The test set then processes the data to find the positive peak, negative peak and the data zero voltage. Note that for asymmetrical waveforms the data zero may not be at the ac coupled zero volt point on the signal. From these three points, the +Vp and -Vp times are determined and the measurement points are then known for the 25%, 50% and 75% pulse width points.

For the display selection, RAM contents are read, converted and sent to the display. The test set determines PASS/FAIL by comparing peak voltages and three pulse width points against corresponding values in ROM, which have been generated from industry standard templates. For the PASS/FAIL indication, the possible measurement error tolerance benefits a PASS indication. A FAIL indication only lights ON when a measured value exceeds the industry standard values by the measurement tolerance. This assures that FAIL lights only for an actual failed condition. Due to measurement tolerances and since all characteristics of the waveform are not tested, it is possible for an input to indicate PASS and actually fail industry standard specifications.

3.3.2 Recharge

Because the test set can operate on battery power, the 120V ac line input is used to recharge the batteries and to operate the test set. When low battery is detected, the low battery alarm sounds and the LOW BAT LED lights on the display. The Waveform Test Set will turn itself OFF in about 5 minutes unless ac is applied. The LOW BAT LED will dimly blink before low battery is detected. Low battery conditions impair the accuracy and operation of the test set. In addition, overly discharging the internal batteries shortens their life. Therefore, the test set has automatic turn OFF. When LO BAT turns ON, you may apply an ac input to the test set and operate it immediately since the charger circuitry has sufficient capacity to recharge the batteries and power the measurement circuitry. Full recharge requires 8 hours. Good practice is to recharge the batteries after every 2 hours of use. You may recharge the test set indefinitely without damaging the batteries.

3.3.3 Test Signal Input

Five input modes are available on the Waveform Test Set: DSX1, DSX1 MON, DSX3, DSX3 MON, and DS3-HI. The monitor level inputs are 20 dB below the normal DSX points and are typically referred to as bridging monitor points. In the monitor modes the Waveform Test Set switches in a 20 dB amplifier to compensate for the loss at the monitor jacks before comparing input signals against CB-119 specifications. Note that the bridging monitor points are usually not accurately controlled and several dB of uncertainty may occur in the voltage readings. (The pulse width measurement is independent of peak voltage.) Set the INPUT SELECT switch for the input type to be measured.

Two input connectors each for the DS1 and DS3 inputs, are industry standard connectors for DS1 and DS3 signals. Adaptors may be used for other connector types. The DS1 inputs are 100 Ω balanced while the DS3 input is a 75 Ω single-ended connector. Apply the input signal to be measured to the appropriate input connector. Only one input should be applied at a time.

3.3.4 Test Measurement

The PASS/FAIL measurement is made about once per second. After each measurement cycle, the test set compares recorded values against industry standard values to determine the PASS/FAIL condition for the Vp, Pulse Width and Symmetry parameters. The positive and negative pulses are independently compared against Vp and pulse width specifications, and if either fails, the FAIL indicator lights. Pulse widths are tested at the 25%, 50% and 75% amplitude points. For best results, allow the test set to operate about 10 seconds before you record data.

The INPUT SELECT switch allows displaying actual values, or enabling the Audible Alarm. The values that may be displayed are: dBx, -Vp, +Vp, +WIDTH, -WIDTH, and SYM. The measurements are standard voltage and nanosecond readings with the scale or units included with the readout.

For the + and - WIDTH measurements, pulse width is displayed at three amplitude points 25% peak, 50% peak, and 75% peak. These are preceded on the

display with a L, M, H (low, midpoint and high) respectively.

When selected, the Audible Alarm enables an internal buzzer that emits a single "beep" after each passing measurement and a double "beep-beep" for each measurement that fails the template comparison.

The POWER ON switch is a rocker type. Pressing the top half will turn ON the test set and pressing the bottom half will turn it OFF. The test set will turn OFF automatically after operating about 5 minutes with no new signal input. If a signal is removed and a subsequent signal applied, the internal automatic timer resets. When a low battery condition occurs, the test set will turn OFF approximately 5 minutes after the condition occurs. When the test set operates on a 120V ac facility line, the automatic power down mode is disabled and the test set will operate until manually switched OFF.

3.3.5 Test Set Check-out

After power-up the Waveform Test Set performs RAM, ROM and measurement circuit self-tests. The alphanumeric display will indicate the type of failure: RAM FAIL, ROM FAIL or NO CALIB. NO CALIB means the measurement circuits are unable to measure the microprocessor oscillator pulses. To verify the test set is operating properly, insert a known signal on the input and observe the results. If the test set does not operate as expected, get shipping instructions and return the unit to Scientific-Atlanta for repair.

The POWER ON switch is a rocker type. Pressing the top half will turn ON the test set and pressing the bottom half will turn it OFF. The test set will turn OFF automatically after operating about 5 minutes with no new signal input. If a signal is removed and a subsequent signal applied, the internal automatic timer resets. When a low battery condition occurs, the test set will turn OFF approximately 5 minutes after the condition occurs. When the test set operates on a 120V ac facility line, the automatic power down mode is disabled and the test set will operate until manually switched OFF.

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APPENDIX A APPLICATIONS

A.1 GENERAL USE

The Waveform Test Set is similar in concept to a handheld digital multimeter and is intended for quick measurement and troubleshooting applications. The test set is not designed for rigorous laboratory analysis applications typical of an oscilloscope. The test set provides measurements and PASS/FAIL indications based on CB-119 Specifications with the margin of error in the measurement placed on the side of the PASS condition. Assuming a typical 5% accurate voltage measurement, the test set will indicate FAIL for those cases where peak voltage is less than 95% of the specified voltage, or 105% of the maximum specified voltage. Similarly for pulse width measurements, the 10% measurement error favors the PASS condition. Thus, if a failure is indicated, you can assume that the input waveshape does not meet template requirements. However, this also means pulses that are marginal or near the edge of the template requirements may PASS on the test set, but in reality are out of specification when viewed with an oscilloscope.

In typical applications where a line is causing trouble, the problem is often due to improper Line Build Out (LBO), cable failure, or intermittent or faulty signal driver. In these cases a detailed scope analysis is not required to find the problem characteristics. An instrument such as the Waveform Test Set that can quickly isolate the faulty cable, LBO or output, is very cost effective in pinpointing the fault.

In these same type applications, a Bit Error Rate Test Set or other monitoring equipment may detect errors but not let you know the cause. By using the Waveform Test Set an over/under range condition, or pulse width/symmetry problem can readily be identified. A Bit Error Rate Test Set or other monitoring equipment operate in the digital domain and the problem may be in the analog domain. The Waveform Test Set being comparable to a

digital multimeter for pulses, complements the use of an oscilloscope and Bit Error Rate Test Set with an easy to carry, operate and use instrument.

A.2 MONITOR POINT TESTING

Typically at a bridging monitor point, a series resistance taps onto the DS1 or DS3 line providing 20 dB of attenuation when terminated into a proper load. The test set provides 100 Ω balanced termination for the DS1 inputs and 75 Ω termination for the DS3 inputs. When plugged into a monitor jack, proper 20 dB attenuation can be expected. However, there are several factors to consider when measuring at a monitor point. The resistors used at a monitor point typically have a ± 1 -2% tolerance, and different values may be used by different vendors which adds to the measurement error. Another factor added by the bridging resistors is that of impedance mismatching and return loss distortion. This is more of a concern at DS3 than DS1, because of the higher frequencies involved. The net result of these factors is increased measurement uncertainty at the monitor jack. The Waveform Test Set allows for this uncertainty by loosening the fail specification by 20% on the peak voltages and an additional 0.5 dB in symmetry at a monitor point before indicating a failure. Internally, the test set includes a 20 dB amplifier to compensate for the monitor losses, so that the monitor point signal may be compared to the CB-119 Specifications.

A.3 LONG TERM MONITORING

The test set may be used for long term monitoring of pulse shapes by operating it on 120V ac which disables the test set time-out feature, active when operating on batteries. The green PASS indicators will remain on continuously if the input waveform has remained within specification for every measurement. If a single measurement was found to fail peak, symmetry or width, and then return to the pass condition, the green PASS indicator will blink to indicate a failure has occurred some time in the test period. To reset the blinking indicator, cycle POWER OFF then ON, or momentarily select another input mode until SIGNAL? appears in the display. After SIGNAL?

appears in the display, return the test set to the desired operating mode. This allows the use of unattended line monitoring to detect intermittent pulse shape problems.

A.4 MEASUREMENT OF DIFFERENT DATA PATTERNS

Data content may vary peak voltage and width measurements, i.e., pulse shape, due to intersymbol interference. Interference occurs when data pulses are no longer square waves and a data 1 pulse does not completely return to 0 before the end of its data period. Thus, if the trailing edge of the data 1 pulse has not reached 0 before the next data bit period, it can increase or decrease the peak voltage and alter the pulse shape of the following data bit.

Since DS1 and DS3 HI retain basically their square wave shape, data type, live traffic, PRBS, 1010 or all ones, will have little effect on the pulse shape measurements. However, for DSX-3, the data type has a measurable effect on the waveform measurements. A DSX-3 blue signal, 1010, provides the most consistent results since the trailing edge of a data 1 has an extra period to die out before the next data 1, and the pulse shape will begin to approach the ideal, isolated pulse shape referenced to in pulse shape specifications such as CB-119. DSX-3 all ones will reduce the peak voltages by up to 20% since a preceding negative data 1 will reduce the amplitude of the next positive data 1, and vice versa. All ones data also reduces the 25% width measurement since the trailing edge is cut off near this point to begin the next data bit. For these reasons DS3 template measurements should not be made with all ones data. Live traffic, or PRBS, will fall between a blue and all ones pattern since 10 data patterns will occur about as frequently as 11 data. The random nature of live traffic and PRBS test patterns causes the DSX-3 measurement to vary more from sample to sample than the other inputs, however, the variations are minimized in the test set by averaging the measurements. Because the sampling network triggers on a pulse and then enables the sampler to take a single point sample on an internally delayed pulse, overshoot or undershoot that extends into the 25% or 75% pulsewidth region may cause erroneous width readings.

A.5 INTERPRETING PASS/FAIL INDICATORS

There are seven potential combinations of failed bipolar pulse conditions and many possible causes of the fail indication. There are some identified common causes of failures which should be investigated. The following paragraphs list the fail combinations and possible sources of the problem.

	V _{P-P}	SYM	WIDTH
PASS			
FAIL			

Indicates the input waveshape is correct but the amplitude is too small or large.

- Check LBO (equalization) setting.
- Check for excessive cable length from the transmission equipment and the cross-connect bay.

	V _{P-P}	SYM	WIDTH
PASS			
FAIL			

The amplitude and ratio of $\pm$ pulse power is within specifications, but the pulse shape is too wide or too narrow.

- Check the high level output of the transmission equipment.

	V _{P-P}	SYM	WIDTH
PASS			
FAIL			

Indicates that the positive or negative pulse is outside of the template, and sufficiently smaller or larger, than the opposite side to cause the symmetry failure.

- Check the high level output of the transmission equipment for bad push/pull bipolar amplifiers.

	V _{P-P}	SYM	WIDTH
PASS			
FAIL			

Implies the positive or negative pulse amplitude is out of specification and that the opposite pulse is sufficiently wider or narrower to compensate for the amplitude variation to keep the symmetry within specifications, i.e., one half of the pulse has greater amplitude and shorter duration than the other half, but they have the same relative power.

- Check LBO (equalization) setting, check for excessive cable length between transmission equipment and the cross-connect bay.
- Check the cable impedance and terminations and check the dB measurement, if 6 dB too high check for far end termination.

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	V _{P-P}	SYM	WIDTH
PASS			
FAIL			

Indicates one side of the pulse is within amplitude and width specifications but near the upper limit, and the other side of the pulse is also within specification but near the lower limits.

- Check the high level output of the transmission equipment.

	V _{P-P}	SYM	WIDTH
PASS			
FAIL			

Indicates a problem with the duty cycle from the transmission equipment.

- Check the high level output of the transmission equipment for bad push/pull bipolar amplifiers.
- Check the cable impedance and terminations.

	V _{P-P}	SYM	WIDTH
PASS			
FAIL			

When all parameters fail first check the signal level setting on the test set.

- Check the LBO (equalization) setting. Check the cross-connect panel for signal connection and/or proper bridging resistors.
- Check the high level output of the transmission equipment.

 = GREEN

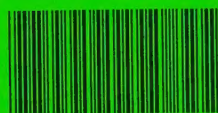
 = RED

Manual Update Information

This envelope is provided for filing manual update information such as corrections to text, tables, procedures, new or revised drawings, or special application notes. Please use your own filing method to list the update entries in the blank space below.

This is an interim step to provide our customers with both errata and new information for this equipment while the manual is being corrected.

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